

HAECKEL AND VIRCHOW:

THE EVOLUTION CONTROVERSY IN GERMANY.

October 1878

AS the meeting of the British Association at Belfast in the autumn of 1874 might be considered as marking an epoch in the history of philosophic thought, in so far as the addresses of Professors Tyndall and Huxley contained a "full, formal, and public recognition of the doctrine of Evolution, carried out to its logical conclusions," so the Conference of the Association of German Naturalists and Physicians at Munich in the autumn of 1877 will long be remembered as marking another epoch—that of a reaction, in the high places of learning, against the dogmatism of science. This reaction has occurred sooner than might have been expected, but it is clear and decisive.

This meeting (corresponding to that of our own British Association) was a remarkable one in many respects. It was the fiftieth anniversary of its organization, and was held as an especial jubilee. It met under Royal personal presidency, and was attended by an unusually large and distinguished assemblage of men of science. But the circumstance for which it will chiefly be memorable was the commencement of a very remarkable controversy between two representative men,

NOTE.—The Essays and Addresses chiefly referred to in this paper are:—

- A. *Die Heutige Entwicklungslehre im Verhältniss zur Gesamtwissenschaft* (The Modern Doctrine of Evolution in relation to General Science). By Ernst Haeckel.
- B. *Die Freiheit der Wissenschaft im modernen Staat* (The Freedom of Science in the Modern State). By Rudolf Virchow.
- C. *Freie Wissenschaft und freie Lehre* (Free Science and Free Teaching). By Ernst Haeckel.
- D. *Natürliche Schöpfungsgeschichte* (The Natural History of Creation). By Ernst Haeckel.

The first two were Addresses delivered at Munich in September, 1877. The third is a "Reply" to the second, appearing in June of the present year. The fourth contains a complete summary, by Haeckel, of the modern doctrine of *advanced* Evolution. To avoid the frequent repetition of cumbrous references, I have distinguished these by letters, by which they will be referred to.

Haeckel and Virchow, which cannot fail to have a powerful influence upon the progress of scientific thought, and which possesses the utmost interest to those engaged in investigating the biological questions of the day.

Professor Haeckel is well known as the representative of the *extreme* school of materialism, and as the avowed and self-constituted champion of Darwinism run mad. He recognizes but one force in Nature—the mechanical; and hence he calls his profession of faith MONISM, in contradistinction to Dualism, which implies a belief in Soul or Spirit, or some force or efficient cause which is other than mechanical. By virtue of this mechanical force, carbon, hydrogen, oxygen, and nitrogen united originally to form the earliest organisms, which appear to have been *monera*; and from these, by casual variation, by selection, by inheritance, and by adaptation, all the forms of animal and vegetable life as we now know them, and as they appear in palæontological records, have been formed. Man himself has no other or especial origin. He is a direct descendant of the catarrhine apes; which, in common with all other *vertebrata*, have been derived from a *single* pair of animals, unknown and unrecorded in history, “for it is unthinkable that all the various and complicated life-conditions which lead through a long course of development to the typical vertebrate animal could accidentally occur more than once in the earth’s history.”*

To promulgate this doctrine, especially that part of it which relates to man’s origin, is Haeckel’s life-long mission. All his works, whatever may be their professed object, relate to this; and his address at Munich had no other end in view. In all this he sees no difficulty, and has no doubts or misgivings. There is no more difficulty in accounting for the phenomena of Life than for the falling of a stone to the earth. “When a stone which is thrown into the air falls again to the earth according to definite laws, when a crystal is formed from a saline fluid, when sulphur and mercury unite to form cinnabar, these facts are *neither more nor less* mechanical life-phenomena than the growth and flowering of plants, than the propagation and sensory faculties of animals, or the perceptions and intelligence of man.”†

Further, there is no essential distinction between living and not-living matter; it is all a “question of degree.” All the natural bodies with which we are acquainted are “*equally living*.”‡ And still further, every atom of matter has a soul—the “Atom-Soul”—which is the sum of the “Atom-Forces;” and when a certain amount of carbon atoms unite with another number of hydrogen, oxygen, nitrogen, and sulphur atoms to form a molecule of protoplasm, called technically a “Plastidule,” the sum of the atom-forces of these elements constitutes a Plastidule-Soul; and thus, “through the *accidental* (*zufälliges*) aggregation of manifold combinations of the constant unchangeable Atom-Souls,

* Haeckel (A), p. 11.

† Haeckel (D), p. 21.

‡ Ibid.

originate the complex and highly variable Plastidule-Souls, the molecular factors of organic life.”*

There is no difficulty as regards the central soul, mind, or spirit (for the terms are used interchangeably) of man. “For all soul-life is ultimately referable to the two elementary functions of sensation and motion, and their conversion into reflex action. The simple sensation of like and dislike (*Lust und Unlust*); the simple motions of attraction and repulsion; these are the true elements from which, in endlessly manifold and complicated combinations, all mental faculties are built up. The love and hate of atoms, the attraction and repulsion of molecules, the motion and sensation of cells and of organisms built up of cells, the thought and consciousness of men,—these are only various steps of the universal process of psychological evolution.”†

Such is a fair and accurate outline of the doctrine propounded before one of the most august and grave assemblages of scientific men ever called together; a doctrine which alone (auc. loq. *einzig und allein*) can give any rational interpretation of the phenomena of the living universe, and of man’s position in it; a doctrine which its author sees written so plainly on the face of all nature, that it admits of no discussion, and requires no proof. He who does not see it is simply, either from misfortune or perversity, blind; and he who demands further proofs than those already furnished, thereby signalizes only his own want of either knowledge or understanding (*nur sein Mangel an Kenntnissen oder an Einsicht*).‡ It is a doctrine which *must* be taught as a part of the national education,—not tolerated merely, but enforced, as the sole panacea for evils, past, present, and future. Has classical education been too predominant? Then teach Monism; it will counteract any evil that may have resulted. Has the reaction in favour of mathematics and the exact sciences been too pronounced? Teach Monism, and the pupil will recover at once the balance of his faculties. Finally, “as this new monistic philosophy has for the first time disclosed the *real* world to our understanding, so will it open to us a new way to moral perfection, in its beneficial application to practical human life. By its help may we now begin to raise ourselves from the condition of social barbarism, in which, spite of the boasted civilization of our century, we are yet plunged.”§ From this sad condition we are never to be elevated by “inner untruth and outer adornment,” or by the effete and mischievous dogmas of Church-religions; but only by the immediate and candid recognition of our ape-ancestry; whereby, by some process as yet imperfectly understood, we shall arrive at the religion of nature. (NATURERELIGION), the only true religion, whose highest commandment is LOVE.||

As to the special application of these speculations, and the reality and exclusiveness of his belief in monism, Professor Haeckel leaves us

* Haeckel (A), p. 14.

§ Haeckel (D), p. 657.

† Ibid.

‡ Ibid., p. 6.

|| Haeckel (A), p. 15.

in no doubt. He is no half-hearted partisan, but has the full courage of his convictions. His views on what he calls Church-dogmas are not left to inference. Matter of itself is all-sufficient to account for all the phenomena of the universe. There is no soul or spirit but such as results from the relations of material atoms. The science of human nature is the science of the mechanical action of particle upon particle. As to the worn-out idea of a God, or Creator of the world, it is so utterly absurd that it can only have arisen in the minds of the *Pithecanthropi*, or ape-men, about the time when they were ceasing to howl, and beginning to articulate.* There is no such thing as free-will;† “on the contrary, by the light of this monistic conception, we see that those phenomena which we have been accustomed to regard as most free and independent, the manifestations of human volition, are subject to laws as firm and established as those that govern all other natural phenomena.”‡ As a necessary consequence, there can be no right, no wrong, no virtue, no vice, no good, no evil; all is inexorable and inevitable fate; and man, the crown and glory of creation, so noble in reason, so infinite in faculties, is but the slave of the soulless tyranny of force and matter,—a brute that, by a series of unhappy accidents, has acquired a conscience, and an infinite capacity for suffering.

Disposed as is the Teutonic mind to speculation, there is a point beyond which it refuses to be carried away either by frothy declamation, or by personal fancies clothed in the semblance of scientific language, and this point Haeckel seems to have overpassed. “The extreme bias of the views propounded formed too marked a contrast to the lofty tone that pervaded the assembly, to be ignored by the more moderate elements present. It was felt that, sceptically inclined as the nation and its learned professors might be, the majority were hardly disposed to adopt the materialist philosophy recommended to them as the only teaching consistent with the rational enlightenment of the times.”§ Nor was it long before this sentiment found forcible expression from one who, both by personal position and scientific attainments, was eminently qualified to speak with authority. The name of Dr. Virchow has been familiar to scientific Europe for thirty or forty years as that of one honoured amongst the most honourable. Formidable as an antagonist, even when opposed in the arena of politics to Prince Bismarck, he is not less so in the domain of science, in which he claims the most unbounded freedom of inquiry. In fact he is spoken of in some of the contemporary journals as the “notorious materialist,” the “Radical Progressionist,” and the “representative of scientific atheism.”|| The writer in the *Times*, already referred to, describes him as not only “opposed to every species of orthodoxy, but altogether innocent of faith.” It is only just to say

* Compare (D), pp. 68 and 657.

† *Anthropogenie*, p. 707.

‡ *Anthropogenie*, *loc. cit.*

§ The *Times* Berlin correspondent, November 30th, 1877.

|| *Neue evangelische Kirchenzeitung*, October 20th, 1877.

that, judging from his essay alone, these opinions would require much modification.

Four days after Haeckel's address, Dr. Virchow ascended the tribune, and delivered a calm, temperate, and philosophical discourse, which produced the profoundest impression, not only upon his audience, but subsequently upon scientific men throughout Europe, the majority of whom felt it to be a promise at least of liberation from the tyranny of the pseudo-philosophic dogmatism which has so long obstructed the progress of true science, founded on observation and experiment.

He did not so much affirm or deny any particular scientific position (although few men are so well qualified to speak with authority on these subjects), as insist upon the necessity of keeping distinctly in view the difference between the *conquests* and the *problems* of science, between the facts and principles which are the property of the commonwealth of science, and those "unverified hypotheses" of so-called "*advanced thinkers*," which on the high authority of Professor Tyndall are merely "figments of the imagination." In his preface to the English translation of his address, he says that "it seemed to him high time to utter an energetic protest against the attempts that are made to proclaim the problems of research as actual facts, the opinions of scientists as established science, and thereby to set in a false light, before the eyes of the less informed masses, not merely the methods of science, but also its whole position in regard to the intellectual life of men and nations."

Dr. Virchow commenced by reminding his hearers of the difference between the position of that Association as regards freedom of thought and discussion now and fifty years back. When first instituted by Oken in 1822, it was considered "so dangerous to hold such an assembly, that it actually met in the darkness of a secret session," and it was not until 1861 that it was thought safe to publish the names of those who attended the meetings. As a contrast to this, he called upon those present to witness the absolute freedom of discussion in the present day, as evidenced in the addresses of Professors Haeckel and Naegeli. He paid a pathetic tribute to the memory of their founder, Oken, who was persecuted and died in exile, on account of those opinions which now every man was free to hold and to teach publicly;—"and so long as a Conference of German Naturalists shall be gathered, so long shall we gratefully remember that this man bore to his dying day all the signs of martyrdom,—so long shall we point to him as one of those witnesses unto blood who have won for us the battle of free inquiry in science."

But (he suggested) that we possess *at present* this unbounded freedom, is no absolute security for its continuance, and he would inquire what we should do to ensure this position.

"I would desire, in a word, to maintain that for ourselves we have now nothing more to ask; but rather that we have reached that point at which we

must specially impose on ourselves the task, *through our moderation, and through a certain abnegation of fond fancies and personal opinions*, to escape the danger of subverting that favourable feeling of the nation which we now enjoy. My own opinion is, that we are actually in danger of imperilling the future through a too unbounded use of the freedom which existing circumstances afford us; and I am anxious to utter a warning against further progress in that wilfulness of advancing favourite speculations of our own, which now prevails widely in many departments of natural science.”*

All the established and demonstrable truths of science may, nay must, be taught. As soon as we can say of anything, “This is a *truth* of natural science,” it should become the common property of the community; such as discoveries relating to “the steam-engine, the telegraph, photography, chemical discoveries, the technic arts of colour, and the like.” Not so with theories and hypotheses which, from their very nature, are not amenable to the ordinary rules of demonstration. Thus,

“It is easy to say that a cell consists of small portions, and these we call *Plastidules*; and that plastidules are composed of carbon, hydrogen, oxygen, and nitrogen, and are endowed with a special soul; which soul is the product or sum of the forces which the chemical atoms possess. To be sure this is possible. I cannot form an exact judgment about it. It is one of the positions which are still for me unapproachable. I feel like a sailor who puts forth into an abyss, the extent of which he cannot see. But I must plainly say that, so long as no one can define for me the properties of carbon, hydrogen, oxygen, and nitrogen, in such a way that I can conceive how from the sum of them a soul arises, so long am I unable to admit that we should be at all justified in importing the *plastidulic soul* into the course of our education, or in requiring every educated man to receive it as a scientific truth, so as to argue from it as a logical premiss, and to found his whole view of the world upon it.”†

Again‡ as to the doctrine of spontaneous generation, or the origin of living forms from non-living matter, it is doubtless a temptation to adopt this extension of the evolution (or descent) theory; and after deriving all living creatures, man included, from one original form, the monera, to link on this to the inorganic world, and to recognize but one force as affecting all these transformations. In this sense there is “something soothing” in being able to say that “the group of atoms, Carbon and Company, has at some time or other dissolved partnership from the common carbon, and founded under special conditions the first plastidule, and that they still continue to establish new branch companies” (p. 34). But it must be remembered that science, as founded upon observation and experiment, tells us something quite different to this. We know now, certainly, that the Harveian thesis, *Omne vivum ex ovo*, is not strictly accurate, as there are other methods by which living creatures originate; as by fission, budding, and alternating generations. But we know also that life does not originate without the presence and influence of pre-existing life. We know of no one single positive fact to show that

* Virchow (C), p. 8.

† Ibid., p. 24.

‡ What follows is, in part, a condensed version of the learned speaker's remarks, so that the quotation marks and references are not always appended.

life has ever originated from the "spontaneous union of Carbon and Company."

"Nevertheless, I grant that if any one is *determined* to form for himself an idea of how the first organic being could have come into existence, *of itself*, nothing further is left than to go back to spontaneous generation. Thus much is evident. If I do not choose to accept a theory of creation; if I refuse to believe that there was a special Creator; . . . if I prefer to make for myself a verse after my own fashion (in the place of the verse in Genesis), then I must make it in the sense of *generatio aquivoca*. *Tertium non datur*. . . . But of this we do not possess any actual proof. No one has ever seen a *generatio aquivoca* really effected; and whoever supposes that it has occurred is contradicted by the naturalist, and not merely by the theologian. . . . If we would speak frankly, we must admit that naturalists may well have some little sympathy for the *generatio aquivoca*. If it were capable of proof, it would indeed be beautiful! But we must acknowledge it has not yet been proved. . . . If, however, any proof should be successful, we would give in our adhesion. . . . But whoever recalls to mind the lamentable failure* of all the attempts made very recently to discover a decided support for the *generatio aquivoca* in the lower forms of transition from the inorganic to the organic world, will feel it doubly serious to demand that this theory, so utterly discredited, should be in any way accepted as the basis of all our views of life."†

Nothing is more hazardous in science than a premature synthesis. It was from this cause that Oken suffered so much in the opinion not only of his contemporaries, but in that of the succeeding generation,‡ because he was one of those who gave synthesis a wider scope in their ideas than a more severe method would have allowed. And when the public see a doctrine which has been presented to them "as certain, established, and claiming universal acceptance, proved to be faulty in its very foundations, or discovered to be wilful and despotic in its essential and chief tendencies, many lose faith in science itself. Then break forth the reproaches, 'Ah, you yourselves are not quite sure; your doctrine, which you call truth to-day, is to-morrow a lie;

* Referring to the well-known history of Bathybius. † Virchow (C), p. 39.

‡ From this cause Oken *deservedly* suffered in the opinion of all those who cultivated science rather than wild speculation. No man in the present century (not even excepting Haeckel himself) has manifested so utter and intrepid a disregard for facts as he. Unless his great work on Physio-philosophy was intended as merely a collection of ingenious fancies, without any practical application, it is difficult to know what was its object. Certainly, if considered as a serious production, it was calculated to inflict most grievous injury on the progress of science. To vindicate this judgment, I need but quote a few sentences relating to the origin and nature of life:—

898. Carbon mixed identically with water and air is *Mucus*.

900. Every organic has issued out of mucus.

901. The primary mucus, out of which everything has been created, is the sea-mucus.

905. The sea-mucus, as well as the salt, is produced by the light. *Light shines upon the water, and it is salted. Light shines upon the salted sea, and it lives.*

884. Galvanism is the principle of Life. There is no other vital force than the galvanic polarity.

885. Organism is galvanism residing in a thoroughly homogeneous mass. . . . A galvanic pile, pounded into atoms, must become alive. In this manner nature brings forth organic bodies.

The numbers refer to the paragraphs in the Ray Society's Edition. In any other science, writers and speakers are expected to keep somewhere near the limits of fact and experience; but whenever and wherever biology comes into question, it appears to be admitted that it is competent to any one to make any statements whatever, if they only sound like science, however absurdly far from the truth they may be.

how can you demand that your teaching should form the subject of education, and a recognized part of our general knowledge?' From such experience I carry away the warning, that if we wish to maintain our claim on the attention of all, we must firmly withstand the temptation to give such prominence to our hypotheses, our edifices of mere theory and speculation, as if we wished to build upon them a whole system of the universe."*

Dr. Virchow afterwards proceeded to notice some of Dr. Naegeli's ideas, and in particular his demand that the province of mind should not only be extended from animals to plants, but that we should finally pass over from the organic to the inorganic world with our conceptions of the nature of mental operations. Professor Tyndall has also conjectured that with more refined faculties we might observe not only the vegetable, but the mineral world responsive to the proper irritants. Finally, Haeckel has made the noteworthy discovery that the one difference between the inorganic and the organic soul is that the latter is endowed with memory!† It is reasonable upon this to suppose that absurdity has reached its possible limits; but it would be interesting to know by what process of intuition or reasoning the writer discovered either that the Plastidule had, or the inorganic atom had *not*, memory. How can he possibly know that "if our faculties and perceptions were sufficiently refined" we might not detect the Old Red Sandstone and the Carboniferous in the act of exchanging confidences and experiences as to the time when the earth was a few million of years younger; or the Tertiary relating to her neighbours that old but ever-fascinating legend of the strange infant that had appeared in her days amongst the gorilla tribe, afterwards known as man? Folly for folly, when dealing with possible supersensuous revelations, one speculation is as good as another.

This mode of thinking of the universal distribution of soul or spirit is (says Virchow) very natural, if you insist on bringing the operations of the mind into connection with the other processes of the universe. For then you are led to extend psychical phenomena observed in man and the higher *vertebrata* to the lower and still lower, even to the lowest animals. Next the plants are granted a soul; then the simple cell is endowed with sensation and thought; and finally the transition is made to the chemical atoms, which hate or love, seek or fly from one another. He continues:—

"This is all very fine and admirable, and may ultimately prove true. It is *possible*. . . . I have no objection to your saying that atoms of carbon also possess mind, or that in their connection with the Plastidule-company they acquire mind; only *I do not know how I am to perceive this*. It is a mere playing with words. . . . The processes of the human mind *may* ultimately find a chemical explanation; but at present, in my opinion, it is not our business to

* Virchow (C), p. 41.

† "Die Plastidul-Seele unterscheidet sich von der anorganischen Molekul-Seele durch den Besitz des *Gedächtnisses*."—Haeckel (A), p. 23.

bring these provinces into connection. . . . Throughout this discourse I am not asserting that it will never be possible to bring psychical processes into an immediate connection with those which are physical. All I say is, that we have *at present* no right to set up this possible connection as a *doctrine* of science; and I must enter my decided protest against the attempt to make a premature extension of our doctrines in this manner, and to be ever anew thrusting into the very foreground of our expositions that which has so often proved an insoluble problem.”*

We are cautioned again and again to keep in view the distinction between what we wish to teach and what we have to search for. The latter are *problems* or hypotheses, which we need not keep to ourselves,—inquiry is *free*,—but we must not give our crude guesses at truth as ascertained data of science; we must say, such and such things are subjects of investigation, and such is our theory at present, subject to after-rectification.

“I am persuaded that only by such resignation, imposed by us on ourselves and practised towards the rest of the world, shall we be able to conduct the contest with our opponents, and to carry it on to victory. Every attempt to transform our problems into doctrines, to introduce our hypotheses as the bases of instruction,—especially the attempt simply to dispossess the Church, and to supplant its dogmas forthwith by a religion of evolution,—be assured, gentlemen, every such attempt will make shipwreck, and in its wreck will also bring with it the greatest perils for the whole position of science.

“Therefore, let us moderate our zeal; let us patiently resign ourselves always to put forward, as problems only, even the most favourite problems that we set up; never ceasing to repeat a hundred-fold a hundred times: ‘Do not take this for established truth; be prepared to find it otherwise; only for the moment we are of opinion that it *may possibly be so.*’”†

On the burning question of man’s pedigree and true position in nature, the learned professor’s observations are interesting and important in the highest degree. He recognizes that almost all students of nature at the present time are of opinion that man stands in some connection with the rest of the animal kingdom; and that “such a connection may possibly be discovered, if not with the apes, yet perhaps, as Dr. Vogt now supposes, at some other point.” He acknowledges that such a discovery is a desideratum in science. He himself is “quite prepared” for such a result, and would “neither be surprised nor astonished if the proof were produced that man had ancestors among other vertebrate animals;” but he feels bound to declare that up to the present time “every positive advance which we have made in the province of pre-historic anthropology has actually removed us further from the proof of such a connection.” The doctrine of a *quaternary* man is no longer a problem, but a “conquest” of science; *tertiary* man is still a problem, although “a problem ready for discussion.”

“Let us, then, in what we have now to say, keep provisionally to the quaternary man, whom we really find. When we study this fossil man of the quaternary period, who must, of course, have stood comparatively near to our

* Virchow (C), pp. 52—55.

† Ibid., *loc. cit.*

primitive ancestors in the order of descent, or rather of ascent, we always find a *man*, just such as men are now. . . . There is a complete absence of any fossil type of a lower stage in the development of man.

"Every addition to the amount of objects which we have obtained as materials for discussion has removed us further from the hypothesis propounded."*

In connection with this subject, Professor Huxley's remarks in his address on Anthropology, at the recent meeting of the British Association, are so apposite and interesting, that no apology is required for quoting them at length.

"Finally, we come to the very interesting question as to whether, with such evidence of the existence of man in those times as we have before us, it is possible to trace in that brief history any evidence of the gradual modification from a human type somewhat different from that which now exists, to that which is met with at present. I must confess that my opinion remains exactly what it was some eighteen years ago, when I published a little book, which I was very sorry to hear my friend, Professor Flower, allude to yesterday, because I had hoped that it would have been forgotten amongst the greater scandals of subsequent times. I did then put forward the opinion that what is known as the Neanderthal skull is, of human remains, that which presents the most marked and definite characteristics of a lower type,—using the language in the same sense as we would use it in other branches of zoology. I believe it to belong to the lowest form of human being of which we have any knowledge, and we know, from the remains accompanying that human being, that as far as all fundamental points of structure were concerned, he was as much a man—could wear boots just as easily—as any of us; so that I think the question remains much where it was. I don't know that there is any reason for doubting that the men who existed at that day were in all essential respects similar to the men who exist now."

Professor Huxley, however, adds that he does not consider this is any argument against evolution. The horse of that period was in all essential respects identical with the horse of the present day; yet, going further back in time, the horse has been traced from an earlier type; and what has been done for the horse *may be* done for man, "although the facts we have before us with respect to him tell in neither one way nor the other." The argument is doubtless perfectly legitimate and scientific, but is far apart from what can be called proof. Virchow traces out almost exactly the same line of thought, and admits that it *may be* that tertiary man once existed in Greenland or Lemuria,† and may at some time be brought to light out of the deep. He thus concludes:—

"Only, as a matter of fact, we must positively recognize that there still exists as yet a sharp line of demarcation between man and the ape. We CANNOT TEACH, WE CANNOT PRONOUNCE IT TO BE A CONQUEST OF SCIENCE, THAT MAN DESCENDS FROM THE APE OR FROM ANY OTHER ANIMAL. We can only indicate it as an hypothesis, however probable it may seem, and however obvious a solution it may appear."‡

* Virchow, p. 61.

† A hypothetical continent in the Indian Ocean,—supposed to have been the original home of man, and called by Haeckel "*Paradies*." Madagascar is supposed to be a remainder of it.

‡ Virchow (C), p. 63. The marks of emphasis are from the original.

The general lesson to be derived from the whole of this thoughtful discourse is not so much the reception or rejection of any particular doctrine or theory, as a recognition of the true *method* of scientific research and teaching. It amounts to this. Science is free, research is free, therefore investigate everything; all knowledge is your domain. The *teaching* of science is free* also; but let this teaching be *according to knowledge*. What you *know*, and can *demonstrate* to be *true*, that you may teach as a conquest, an acquisition of science, and it may become the general property of the commonwealth of science. What you only conjecture, what is but an hypothesis, however plausible or probable it may appear,—that teach only *as* an hypothesis, subject to after-correction. Above all, be careful not to build upon any such doubtful hypotheses large systems of nature and of human life, which may have a serious influence upon the social and moral relations of man.

This position is so plain and reasonable in every respect, that it might be supposed to carry with it so strongly its own recommendation that no one could object to it; it is so clearly expressed, so often repeated, so guarded and elucidated by illustrations from various branches of knowledge, that it would almost appear impossible to misunderstand or misrepresent it. Yet this all but impossible feat Haeckel, in his "Reply," has with characteristic ingenuity accomplished. This injunction, "Teach as fact what you know to be fact, but as hypothesis what you only know to be hypothesis," Haeckel interprets into an attack upon the freedom of science, and a hint to nine-tenths of the professors in Europe to leave their chairs.† He adds that Virehow has unfortunately omitted two important words from the title of his discourse, which ought to be read, "The Freedom of Science in the Modern State *must cease* (*muss aufhören*)."‡

But indeed this "Reply" is in all respects a most remarkable and querulous production. Considered as a criticism upon Virehow's address, it is so far astray apparently from any comprehension or appreciation of its meaning, that it might almost be supposed he had never read the address, but only received a second-hand report from a negligent hearer. As a contribution to science it is absolutely *nil*; as an anthology of vituperation it is copious and comprehensive, if not very select or refined. That any one has ventured to express dissent from, or hesitation even about accepting, his favourite doctrines, seems to have driven him altogether beyond the bounds of discretion and propriety. There is no name, however obscure, that is not elevated by a belief in Evolution. There is none, however distinguished, that is not deemed a fitting object for reprobation, if its possessor does not accept these doctrines. The great and venerated name of Von Baer is associated with the idea of "harmless

* "Die Wissenschaft und ihre Lehre ist frei."—§ 152, *der Verfassung des Deutschen Reichs*.

† Haeckel (C), pp. 4 and 6.

‡ Ibid., p. 71.

senile garrulity." He was, it is alleged, even in 1859, incapable of understanding* Darwin's book on the Origin of Species. Adolf Bastian is a "Privy-Councillor of Confusion;"† Du Bois-Raymond is a "rhetorical phrase-spinner,"‡ if not a Professor of Voluntary Ignorance; Carl Semper is a—a person regardless of truth; expressed in a brief word not usually used amongst gentlemen. Naturally the fullest vials of wrath are poured upon Virchow himself, who is a "*Finsterling*," a benighted bigot, who has lent himself as a tool of the most dangerous reaction; an advocate of "*Creatismus*." He is ignorant of geology, of zoology, and of palæontology; he has not the remotest suspicion (*ahnung*) of the progress of morphology; he is, in fine, and to sum up all in a word, even more ignorant than Baer himself.§ He is not in any way competent to express an opinion on these questions; for all of which he is not so much to be blamed as pitied.|| I forbear to quote further, although a very large proportion of the ninety-three pages of the "Reply" is devoted to similar imputations.¶

In presence of such an ebullition as this, it may not perhaps be deemed out of place to suggest to men of science and others that this practice, which has become of late years so marked a feature in certain discussions, of bandying about charges of ignorance and incompetence without proof or illustration, is not only "bad form," but has the strongest tendency to bring science and its professors into discredit and contempt. That writers of the *guerilla* type should have only feeble personalities wherewith to meet a serious argument is natural enough; it surprises no one, and leaves the question at issue entirely unaffected; but that true men of science, who have moreover been to some extent exercised in *civilized* polemics, should condescend to the use of such weapons, speaks volumes for the weakness and untenability of the cause they advocate. It might be well to recognize candidly that the opponents of the modern doctrines of Evolution have just as accurate and comprehensive a knowledge of the facts and the modes of thought that lead to such views of nature as those that hold them. The one difference between them is this—that the Evolutionist looks upon all these phenomena as susceptible of *one* interpretation only; whilst those who have not accepted this doctrine have formed their belief, not in ignorance of these phenomena, nor regardless of their deep significance; but in the conviction that they are to be explained by at least *two* other (probably many more) hypotheses, amongst which the least probable, and the least in accordance with all known observations and analogies, is that which is now so widely accepted.

Let me take as an illustration the question of the origin of life and

* Haeckel (C), p. 24.

† Ibid., p. 13.

‡ Ibid., p. 81.

§ Ibid., p. 24.

|| Ibid., p. 27.

¶ Haeckel has probably never heard of the insignificant names of Owen, Milner, and Agassiz, or they would doubtless have been remembered in the catalogue of wretched smatterers who have come under his signal disapproval.

living matter. The Monist believes that these were originally formed by the accidental aggregation and union of their inorganic elements, as a mechanical phenomenon. If I (speaking *impersonally*) cannot see my way to accept this view, it *may be* that this inability does not arise from an ignorance of the line of thought that seems to necessitate such a conclusion, nor from any disposition to undervalue its importance, or the interest that attaches to it. It may arise from this, that I know these elements, carbon, hydrogen, oxygen, and nitrogen, not only appear to have no strong affinities or tendencies to unite at the temperatures within the limits of which alone life can exist, but that by no process of which science is cognizant can they be *made* to unite at any temperature whatever—not into living matter only, but even into any chemical compound bearing any resemblance to anything that can live. So much at least ought to be taken into consideration as an extenuation of my blindness. If I am told that there were *conditions* when the world was young, that we cannot reproduce now, I profess (and bewail) my utter inability to realize such “conditions.” If the cosmic forces were then the same *in nature* as they are now,—say heat, chemical force, light, electricity, &c., with varying moisture,—then I believe science is competent to reproduce any combination of any or all of these with which life is compatible. I cannot picture to myself material *conditions* which are not to be expressed in terms of matter and force, but if other *forces* were then in operation of which we now know nothing, the whole question becomes chaotic, and he is not necessarily blind who cannot see his way through it. Meanwhile, it may be mentioned that even those who hold most firmly the mechanical doctrine of life, by all but universal consent acknowledge that the production of life from non-living matter has never been witnessed. Haeckel himself confesses that hitherto the results of all attempts to demonstrate this “have been only negative.”

Apart from much laudation of the Descent-theory, and innumerable charges of ignorance and incapacity against all who do not accept it, there is not much in Haeckel’s “Reply” that will repay any lengthened analysis. In his preface he commences by announcing that the doctrine of Evolution, the foundation of all biological science, and the most valuable acquisition of all educated humanity, is so firmly established and proved, that neither the curse of the Church nor the opposition of “the highest scientific authority, even though his name be Virchow,” can affect its stability—a mode of *argument* not entirely unknown in England. In the first chapter, entitled “Evolution and Creation,” he again sets forth the monistic doctrine, which he defines as being a comprehensive philosophic conception of the universe, of which the leading idea is “that in the whole of nature one great, uniform, uninterrupted, and eternal course of development is in progress, and that all the phenomena of nature without exception, from

the movements of the heavenly bodies, and the falling of a stone, to the growth of plants, and the consciousness of man, follow one and the same great causal law, and that all are ultimately to be referred to the mechanical action of atoms;”* upon which it may be remarked, in passing, that it would be above all things interesting could such a “causal law” be traced and its *modus operandi* made intelligible; but up to the present time we have been left altogether in the dark as to how this mechanism effects any part of the wonders ascribed to it; or how, with only *one force* in operation, any differentiation could ever have originated.

Haeckel next proceeds to set forth the merits of “Lamarckism” and “Darwinism,” both of which he contrasts, much to their advantage, with the “absurd and untenable” doctrine of “creation.” These he considers proved beyond all doubt or discussion, but in the second chapter he retraces what he calls the “certain proofs of the Descent-theory,” which are based upon “the facts of comparative morphology and physiology, of rudimentary organs, of embryonic development, of fossil remains, and of the geographical distribution of organisms.”† If these are not sufficient, “where in the wide world are we to look for proofs?” and why does not Virchow or some of his “dualist” associates point out where they are to be found? Is it that they want *experimental* proof of the metamorphosis of species? This demand is preposterous (*verkehrt*), and only shows their ignorance of the essential nature of the theory. And yet, he proceeds, these proofs have been furnished innumerable times; witness the modifications of the horse under domestication, and the innumerable varieties of the pigeon. How Virchow can want anything more seems to him incomprehensible; the only explanation that he can imagine to himself is this: that Virchow has never read with any care either Darwin’s book or any other on that subject, or if he has read he has not understood them.‡ To this subject I will recur shortly, but now proceed with the sketch of the essay.

In his third chapter Haeckel re-affirms his ape-descent theory, without any new confirmation except this, that man must be descended from the apes, because he, Haeckel, whom “no one ever accused of being deficient in imagination,” has often tried, but never succeeded in the attempt, to represent to himself “any known or unknown animal form” as the nearest ancestor of man except the ape—“I always return again and again to the ape-pedigree as of absolute necessity.”§ What is wanting in argument, however, is again supplemented by angry denunciations of Virchow’s ignorance, and by that freedom and breadth of style in the production of unexpected facts, which may be called license in science, and which has now become a

* Haeckel (C), p. 10.

† Ibid., p. 16.

‡ Condensed from pp. 16—20.

§ Ibid., p. 38.

by-word in some parts of Germany under the name of *Haeckelism*.* In the fourth chapter the nature of "soul" is discussed, and it is made to be a mechanical product of the action of atoms in combination; with the same disappointing result as before, that we learn nothing about *how* atoms can represent consciousness, but have to be content with a wilderness of barren words. In this chapter, also, the division and subdivision of the original plastidule, and the formation of the various tissues by this process of differentiation, are dwelt upon at some length. I wonder if Haeckel ever propounded to himself this problem:—"From one original homogeneous molecule of plasma, by means of *one force only*, the mechanical, to form millions of other molecules, of many perfectly distinct and different kinds." The solution would be interesting.

In his fifth chapter, on "The Genetic and Dogmatic Methods of Teaching," Haeckel criticizes Virchow's recommendation to teach as absolute objective truth only what we know to be such, and attempts to show that our domain would thus be indefinitely limited, asking the question finally, as expecting and suggesting a negative answer, "*Is there such a thing as objective truth?*"† He proceeds to intimate that even mathematical science cannot be said to be certain and objective purely, inasmuch as many "mathematicians, physicists, and philosophers of the present day" believe in space of more than three dimensions. He then proceeds to ask, what do we *know certainly* of the essential nature of matter and force? what of gravitation, of attraction of masses, of action at a distance? What do we know of the essential nature of electricity or magnetism, of the so-called "electric fluid," or of the imponderables generally, whose very existence is not proved? What do we know of the æther, upon which our formal science of light and optics is founded, and what of the theoretical foundations (as the atomic theory) on which our chemistry is built? Yet are we, he asks, to cease to teach these sciences, because we do not *certainly* know these things?

To all this the answer is almost too evident to require formulating. We know *nothing* of the *essential nature* of matter, force, or anything whatever; but we observe and verify phenomena, not as we fancy they ought to be according to the requirements of a preconceived theory, but as we can show and demonstrate them to others. These phenomena we arrange and classify into sciences, and teach them as the "conquests" of science. To aid systematic thinking, we also theorize, and we enunciate our theories as aids only. The theories may be true or false; they may, and do, vary from year to year, but the science collectively remains. Thus we speak of the "electric fluid," but most of us only use it as a convenient formula; or of the "electric current," although it is much doubted whether anything

* *Vide Der Haeckelismus in Der Zoologie. Von CARL SEMPER. Hamburg, 1876.*

† Haeckel (C), p. 52. "Gibt es überhaupt eine objective Wissenschaft?"

runs or flows, or not. The theory of electricity is altogether detachable from the facts, which remain unaffected, whether we think of electricity as of one fluid, or two fluids, or no fluid at all, but only a kinetic phenomenon. Thus, Mr. Latimer Clark says, in his introduction to his valuable treatise on "Electrical Measurement," that without "in the least offering an opinion on the point, I would advise (the student), until his views are more matured, to regard electricity as a *substance*, like water or gas, having a veritable existence; and although easily convertible into heat, and *vice versâ*, in other respects indestructible." Professor Clerk Maxwell is equally guarded, and to avoid the misconception that might arise from the use of the word "current," as expressing a fact rather than a theory, he says that "all that we assume about it is that it involves motion of some kind," but whether the motion referred to is "the tenth of an inch an hour, or a hundred thousand miles in a second, we know nothing."*

In like manner, we teach the facts of chemistry. We teach, for instance, as a demonstrable fact, that chemical elements tend to combine (when they do combine) in certain definite invariable proportions, that can be numerically expressed. When we come to explain *why* this is, we theorize on atoms, &c., and we teach the result *as* a theory, the facts remaining the same whether our theory be true or false. Thus, for the *weight* of a supposed atom, we may, for the convenience of thinking, mention it as so many microcriths; but we never teach that the microcrith is anything more than an *ens rationis*, or a convenient name for comparison. We may say that a *molecule* of hydrogen weighs two of these microcriths, one of oxygen thirty-two, and one of nitrogen twenty-eight, and so forth; it is a convenient way of expressing and representing to the mind a possible and probable theory of our known fact that such and such bodies combine in such proportional weights. We never assume that the microcrith is a reality, and build up a science on the name. As to force and matter also, we know nothing, and therefore teach nothing, as to their essential nature. We try to ascertain what *must be* true about the constitution of matter, on any theory;† and we attempt to demonstrate the *results* of "energy" under conditions open to investigation. These results are apart from, and remain entirely unaffected by, any theory we may hold as to the nature of "energy" in itself.

The same holds good with regard to all the other instances of the imperfection of our knowledge. In all these, the theory or the hypothesis is an aid to thought or classification, but never interferes in the domain of fact. Far different is the case with the monistic theory, the "transformation of species" theory, and the human ape-pedigree hypothesis. In these, the theory and the facts are "solidary;" they

* Treatise on Electricity and Magnetism, p. 196.

† As in Professor Tait's most interesting investigations into the "coarse-grainedness" of matter.

stand or fall together. There is no theory but such as consists of facts; there is no fact that does not *constitute* the theory. If there is no theory, there is no fact. Therefore, teaching the theory is teaching the fact, and *vice versâ*. It follows, then, as a matter of necessity, that we ought to ascertain the facts before teaching the theory. And as no *direct* facts have been ascertained bearing on the question, a due reticence should be observed in teaching the theory.

Reluctantly acknowledging that we have no direct or immediate knowledge of the transformation of species, Haeckel affirms that the proofs of it are of the same order, and as strong, as those of our historical knowledge, or of the sciences of geology or language.* Again these illustrations are abortive. We believe in history generally, though not in all its details, because history is always *making* under our own observation; we cannot form any conception in our minds of a time without history, and we connect and trace back its records with a certain amount of assuredness. We believe in a science of language and its modifications, because we know by familiar observation that certain changes are constantly taking place in the literature and the spoken language of nations, and the systematization of these is, in part, the science of language. We believe in certain broad features of our geological theories, such, for instance, as relate to some stratifications, and the organic remains found in them, because we can intelligibly and rationally connect them historically with the processes of deposit, of denudation, of elevation and depression, that we may see for ourselves always going on at the present time. All this kind of evidence is absolutely wanting in the monistic hypothesis. We cannot observe one single phenomenon in the present, indicating either a tendency towards the formation of living matter from its elements, or plasticity in the physiological characters of species, which would warrant us in saying that we could rationally infer from it important changes in the past times.

Haeckel is very angry that Virehow has not *discussed* his arguments, but has made a "joke" upon his "favourite fancies." Perhaps for this there may have been more reasons than appear on the surface. Haeckel was an old pupil and friend of Virehow, and it may well be that the latter would wish to be very considerate of the old relationship; and that whilst wishing definitively to enter the strongest protest against the dogmatic teaching of non-science, he would accomplish this in the way least likely to wound his former friend. He might have said, "Your facts are not gathered from nature; your premises are inaccurate, and your conclusions unwarranted; your whole system is a fanciful and ill-arranged mistake." Instead of which he says, "All you say *may be* true, and it *may* at some future time be *proved* to be so; but I do not see at present how I am to arrive at a knowledge whether it is true or not. You say an atom of carbon has a soul,

* Haeckel (C), pp. 55—58.

which only differs from an organic soul in not having memory. This *may be so*, but I *know* nothing about it. It would be safer not to teach such doctrines until they are *certain*, and can be demonstrated to be true; for if this be adopted as the foundation of a comprehensive theory of life and human nature, there is no knowing what mischievous moral consequences might result."

There is another reason why perhaps a *discussion*, in the ordinary acceptation of the term, of Haeckel's doctrines, would be unprofitable, if not impossible. Haeckel finds life in the falling of a stone to the earth, and in the motions of the heavenly bodies; he finds soul or spirit in the ordinary phenomena of attraction and repulsion; and lastly, he finds *Christianity* in the daily life and actions of the ants, and in the social instincts of the higher animals generally!* In all this there is manifested either such a hopeless confusion of thought, or so reckless a disregard of the received terminology of science, that an ordinary man, using words in their legitimate and accepted sense, can neither find common ground whereon, nor a common language wherewith, to conduct a discussion. They must be continually breaking down through mutual want of comprehension. *Living* and *non-living* are terms or expressions for well-understood conditions,—understood, that is, as to the *contrast* between them. *Life* is a collective term for certain phenomena which are only manifested in and by matter in a very complex, and uniformly complex, state of combination. To say, then, that everything is "equally living," is merely a foolish and unmeaning phrase, which has the effect of rendering a science of biology impossible.

Another difficulty which would arise, were any discussion of Haeckel's doctrines seriously contemplated, is this. Haeckel has, if not an actual, certainly a comparative contempt for facts. He considers that the "perception of general laws" is a much more exalted aim for the naturalist than the observation of details,† overlooking the consideration that without such observation, no general laws, worthy of the name, can be formulated; and also that such laws, to be of any interest or value, must comprehend *all* details, and be inconsistent with none. When facts, however, are absolutely required, he is rarely at a loss for them. They do not appear always to be gathered from a contemplation of nature; nor are they always such as are known to other naturalists even of the most extended experience; but they are generally of such a nature and tendency, that they fit in most remarkably with the requirements of the theory then under discussion. A striking illustration of this is met with in his remarks on the origin of new species by means of the fertility of hybrids. Contrary to the opinion of naturalists generally, which is to the effect that hybrids are

* He considers that ants perform their various functions from a "sense of duty" (*Pflicht-Gefühl*); and that this is "in the best sense of the word, *Christian*." Haeckel, (C), p. 76.

† See A, p. 5.

for the most part virtually sterile, Haeckel announces, without much attempt at proof, that the instances of sterility are the "rare exceptions," and that fertility is the general rule.* To such assertions no reply is possible, or required.

But whoever would see at one comprehensive glance the mode in which the theory of man's ape-descent is constructed, the airy foundation on which it is built, and the imaginary facts that are employed in the edifice, cannot do better than peruse carefully the twenty-second chapter of Haeckel's "Natural History of Creation," where we find a complete and circumstantial history of our ancestry in twenty-two stages or forms of existence, from the unicellular *Monera* up to the perfect man. Du Bois-Raymond has earned for himself the bitter and undying hostility of Haeckel, by pronouncing this genealogical tree (*Stamm-baum*) to be as authentic in the eyes of a naturalist, as are the pedigrees of the Homeric heroes in those of an historian.† The argument is round and complete as a circle. What are the proofs of man's descent from the ape? The facts of ontogenesis and phylogenesis,‡ and their correspondence. Where are these facts enumerated? In the chapter as before mentioned. What is the authority for these facts? Chiefly that they are necessitated by the exigencies of the theory. Is there any evidence, that is, any direct and demonstrable evidence, that creatures representing these twenty-two stages ever existed? Not absolutely so, in the majority of the instances; but they "must have existed," otherwise the theory would be imperfect.

I have elsewhere§ shown by many quotations that this is a correct outline of the mode of proof adopted. I must add here one or two illustrations. Of our earliest "ancestors," the *Monera*, it is stated, as a plain historical fact, that "they originated about the beginning of the Laurentian period, by *archebiosis* or spontaneous generation" from "so-called inorganic compounds of carbon, hydrogen, oxygen, and nitrogen."|| It is perhaps needless again to mention that of this there neither is, nor can be, the faintest shadow of proof; but the fundamental law (*Grundgesetz*) of ontogenesis absolutely requires it. It is not improbable that naturalists may by-and-by get tired of this *Monera*, and the doctrines that are grouped around it. In his Munich address, Haeckel again tells the old, old story (as if it had not been a

* I subjoin the passage in the original:—"Früher galt es als Dogma, dass zwei gute Arten niemals mit einander Bastarde zeugen könnten, welche sich als solche fortpflanzen. Man berief sich dabei fast immer auf die Bastarde von Pferd und Esel, die Maulthiere und Maulesel, die in der That nur selten sich fortpflanzen können. Allein solche unfruchtbare Bastarde sind, wie sich herausgestellt hat, seltene Ausnahmen, und in der Mehrzahl der Fälle sind Bastarde zweier ganz verschiedenen Arten fruchtbar und können sich fortpflanzen."—D, p. 245.

† Darwin versus Galvani, 1876.

‡ *Ontogenesis*, the history of individual development, from the cell-germ to the perfect form. *Phylogenesis*, the genealogical history of the race, from the most simple to the highest forms of animal (or vegetable) life.

§ Winds of Doctrine, chap. viii.

|| D, p. 578.

hundred times blown into the "infinite azure"), that "the Monera, consisting of protoplasm only, bridge over the deep chasm between organic and inorganic nature,—and show us *how* the simplest and oldest organisms *must have* originated from inorganic carbon compounds."* It cannot be too plainly expressed or understood, that the Monera *bridge over nothing whatever*; nor show in any conceivable way *how* life has originated from inorganic compounds. The protoplasm of these *apparently* simple organisms is just as far removed chemically and dynamically from inorganic matter as is the protoplasm of the lion or the eagle. There is not the least known reason to infer that they are the oldest or earliest organisms; but this kind of statement has obtained a considerable currency amongst certain talkers and writers, chiefly by loud and positive repetition; as if the error of to-day should obtain a certain kind of relative truth by being reasserted to-morrow. But this is a digression, and I proceed to notice some other of our improvised ancestors.

Passing over the Amœboids, and the Planœada, we arrive at another important group of ancestry, the *Gastrea* which "*must have* existed in the primordial time, and have included amongst its members the direct ancestors of man." No one ever saw one of this group; there are of course no traces of its existence; but the "*certain proof*"† of their existence is found in the fact that the Amphioxus, at one period of its development, presents a type similar to that of the imagined *Gastræa*!! Our ancestors, the worms, come next; and they "*must have* existed" because comparative anatomy and ontogenesis seem to require them as the parents of the higher worms, and the articulates generally. Then this being established as a scientific truth, the *Scolecida*, next in order, are "proved" to have existed by the comparative anatomy of these worms and of the Amphioxus again.

But the most daring and brilliant effort of the imagination is met with at that point which separates the *Invertebrata* from the *Vertebrata*. This, which has always been a stumbling-block and rock of offence to our universe-constructors, is no difficulty whatever to Haeckel. Modern speculators have fixed upon the *Ascidia* to "bridge over" this chasm; but as there are some few insuperable difficulties in the way of accepting that theory, our author invents an altogether new type, the *Chordonia* (*Chordathiere*), to be the common parent both of Aseidians and the *Vertebrata*. They "developed themselves"‡ from worms, merely by the formation of a *chorda dorsalis* and a spinal cord—uneonsidered trifles that cost but the stroke of a pen, and render everything easy and comfortable for the future. Having once got vertebræ, our ancestors got on swimmingly. We are traced happily through fishes and amphibia, until we meet with another little difficulty in getting at the mammalian type; but this is accomplished by means of the *Protamniota* leading to the *Promammalia*, types of which no one knows anything or

* A, p. 13.

† D, p. 531.

‡ Ibid. p. 533.

can form any definite idea, but which again *must have* existed to render the theory coherent. The class directly preceding these is said to be “*necessitated* as a connecting-link between the former and the following stages.”*

Through *Marsupials*, *Prosimia*, and the lower apes, we arrive at the anthropoid apes, which “developed themselves from the catarrhine apes, about the middle of the tertiary period, by loss of the tail and a great part of the hair, and by a preponderating development of the brain-pan over that of the facial bones.”† It is, however, distinctly specified that man has not descended directly from any form of anthropoid ape now known, but that our immediate ancestors must be sought amongst the *unknown* and extinct apes of the Miocene period, probably in Lemuria, or in the tertiary deposits of Southern Asia or Africa. The *Pithecanthropi*, or “dumb ape-men,” come next and last before man. The nearest modern representatives of these are said to be “cretins and idiots,”‡ and from these the “true man” developed himself by ceasing to howl and beginning to articulate. Such is the long, sad, and dreary history of man! I wonder how he ever became a *laughing* animal?

Having thus passed in review so much of the evidence, both for the general theory of transformation of species, and for the special case of man’s ape-descent, as is necessary to indicate its nature and tendency, we are now in a position to return to and answer Professor Haeckel’s question, “What more do you want, and where in the whole world are we to look for further proofs of the doctrine of Evolution?”§ And notwithstanding that he anticipates the answer, and pronounces it “preposterous” and a mark of ignorance, I venture to say that what is further required is some experimental demonstration of the *possibility* of the processes and principles involved in the doctrine of Evolution or Monism. It may be conceded at the outset that, *could* this possibility be demonstrated, the phenomena now relied upon as *proofs* would afford the strongest confirmation and plea for the reception of this doctrine. But, although they would fit in admirably as illustrations of an hypothesis, the fundamental principles of which could be shown to be admissible in accordance with general experience, they cannot stand as proofs of an impossibility. We want further proof under three heads of inquiry—first, as to the origin of life and living matter; secondly, as to the possibility of the metamorphosis of species; and thirdly, as to the solidarity of man’s nature with that of the brutes. And before making a few observations on each, it may be well to premise that the anti-evolutionist is not so unreasonable in his requirements as is often represented. He does not demand that a living animal shall be constructed out of inorganic elements in the laboratory; he does not ask to witness the actual process of transition from one species of animal to another; he does not claim to see any family of

* D, p. 537.

† Ibid., p. 590.

‡ Ibid., p. 592.

§ C, p. 15.

apesso cultivated, varied, and "selected," that the transition to humanity is approached; but he does wish to have some such slight experimental proof as will help him to attach ideas to the forms of words that are now given as representing doctrines.

1. As to the origin of Life. We are told in all monistic treatises and essays that living matter arose out of inorganic matter by the (accidental*) union of its elements. Professor Fiske, in his "Outlines of Cosmic Philosophy," is more circumstantial. He explains that—

"In accordance with the modern dynamic theory of life, we are bound to admit that the higher and less stable aggregations of molecules which constitute protoplasm were built up in just the same way in which the lower and more stable aggregations of molecules which constitute a single or double salt were built up. *Dynamically, the only difference between carbonate of ammonia and protoplasm, which can be called fundamental, is the greater molecular complexity, and consequent instability of the latter.* We are bound to admit, then, that as carbonic acid and ammonia, when brought into juxtaposition, united by virtue of their inherent properties, as soon as the diminishing temperature would let them, so also carbon, nitrogen, hydrogen, and oxygen, when brought into juxtaposition, united by virtue of their inherent properties into higher and higher multiples, as fast as the diminishing temperature would let them, until at last living protoplasm was the result of the long-continued process."†

The same writer mentions a few pages earlier that "*all unverifiable hypotheses are inadmissible.*" Let us inquire to what category this quotation belongs. In the first place, there is no similarity in the composition of protoplasm and carbonate of ammonia; and dynamically, no resemblance whatever, even the most distant; as is well known to all chemists and physiologists. Then again there is no cogency in the argument that we are "bound to admit" something that we know *does not* happen, because we admit something that *does*; for with exactly the same definiteness and certainty that we know that carbonic acid and ammonia *do* unite, when brought into juxtaposition, we know that carbon, hydrogen, nitrogen, and oxygen *do not*. These elements have no direct affinities at such temperatures as are compatible with life; and in fact cannot be forced into combination so as to form anything even remotely resembling protoplasm.

It might be well for those writers who explain so easily "the mystery and the miracle of vitality," as consisting only in "the compounding, in the organic world, of forces belonging equally to the inorganic,"‡ to ask themselves if they attach any definite idea to such forms of words, or if they are but phrases intended to amuse the unscientific mind. Let us try to realize for a moment what these forces are, and what such compounding must be. From a little water which holds in solution tartrate of ammonia, with a small amount of phosphates and sulphates, the *penicillium* will in a short time produce a quantity of living matter

* Haeckel.

† Cosmic Philosophy, vol. i., p. 433.

‡ Tyndall's Fragments of Science, p. 462.

many million times the weight of the original spore,* in protein compounds and cellulose. This living matter is of the utmost complexity of structure and composition; each molecule (= *plastidule*) containing probably at least five or six hundred elementary atoms.† To build up this elaborate edifice, the most complicated in chemistry, is perhaps the least of the difficulties involved. Before the building up is commenced, a process of destruction or decomposition must have taken place, which requires forces *utterly unknown* to us amongst inorganic agencies. To say nothing of the separation of sulphur from the sulphuric acid, we must consider that carbonic acid has to be decomposed, and that in our laboratories this is *practically impossible*, or at all events at any temperature, or under any conditions approaching those that are compatible with living processes. It is no theory, but a simple matter of plain indisputable fact, that the force or forces employed in the analyses and syntheses of organic processes are quite unknown to us in the inorganic world, and no "compounding" whatever of these latter forces will in the remotest degree represent the former.

Finally the hypothesis of "higher and higher multiples" is a pure invention. We know nothing of them; nor of any intermediate gradations between the comparatively simple inorganic compounds of carbon, &c., and the very complex matter in which alone life is manifested. If these four elements combined originally to form living matter as soon as the cooling temperature would allow, why do they not do so now? And if they do, why do we never catch a few of these "multiples" in the transition period? Or why cannot we artificially indicate the possibility of the existence of some of these gradations? *Ex uno disce omnes*. The proper province of the Evolutionist is to assert—not to prove. What we want under this head is some proof that "Carbon & Co." *will* unite to form something like living matter. If we cannot have this proof, we must be pardoned if we consider it rather ridiculous to persist in relating, as an historical fact, that such *was* the origin of life on our earth. Perhaps it may have occurred where space had four or more dimensions; but in our old-fashioned kind of space the phenomenon has not been witnessed.

2. What further proof do we want of the truth of the doctrine of mutability and progressive development of species? In answering this question we cannot do better than quote and accept the very thoughtful and weighty conclusion of Professor Huxley, that "should such an hypothesis eventually be proved to be true," the "*only way in which it can be demonstrated*" will be "*by observation and experiment upon the existing forms of life.*"‡ And again in another place, the same high authority tells us, that "our acceptance of the Darwinian hypothesis must be provisional so long as one link in the chain of evidence is

* See Huxley's essay on "The Border Territory between the Animal and Vegetable Kingdoms," in *Macmillan's Magazine*, for February, 1876.

† Liebig's formula for albumen is $C^{216} H^{358} N^{51} S^3 O^{68}$.

‡ On "Persistent Types of Life," in *Lay Sermons, &c.*, p. 226.

wanting; and so long as all the animals and plants certainly produced by selective breeding from a common stock are fertile, and their progeny are fertile with one another, *that link will be wanting.*”* Although this last passage was written eighteen years ago, it is as true now as it was then, and the link is still missing.

What are we taught by “observation and experiment on existing forms of life?” Plainly and unmistakably this,—that the *physiological characters* of species are absolutely constant and unchangeable. The *secondary characters* are indefinitely variable; to such an extent that the different varieties of one species are often apparently further removed from each other than some of those which are known to belong to different species. Yet breed, select, cultivate as we will, we cannot break down the essential characters of the group, considered as fertile *inter se*. The horse, whether it be Arab, Cleveland, Suffolk, or Clydesdale, is always a *horse*; and never becomes a something else, founding a progeny infertile with the original horse, but fertile with its own members. That Haeckel should offer this case of the varieties of the horse as an “experimental proof” of the variability of species, is only another illustration of my position, that in questions relating to biology, any formula or assertion is deemed good enough, if it only seems to support the doctrine of Evolution.

I am aware that in these days, when this word evolution is the shibboleth of modern enlightenment, such views as the above are considered to be so limited, contracted, and altogether “ignorant,” as to be only worthy of contempt. Dr. Büchner, whose learning is only equalled by his refinement and modesty, calls us “speculative idiots;” and in so doing scarcely misrepresents the estimation in which such doctrines are very widely held. Yet I would again urge in extenuation of this benighted state, that he who upholds the doctrine of the fixity of species is at least supported by all the phenomena of nature, *as we know and can observe them*; whilst those who maintain the variability of species are only supported by inference and deduction from facts and observations which are susceptible of many other interpretations. It is simply the question, shall science be built up on the rock of fact and truth; or shall it be based on the shifting foundation of personal fancy and hypothesis? Apart from these, we have no warrant whatever for assuming the development of all the various forms of organic life from “one or a few”† simple forms. There is no direct evidence, even the slightest, that one species ever gave rise to another. There is no such thing *observable* in nature as “specific variability;” there is no instance known of the occurrence of what is called a “favourable variation;” there is none even intelligently suggested.‡ There is no

* Man's Place in Nature, p. 107.

† Haeckel.

‡ Mr. Darwin, speaking of this difficulty of imagining the nature of a “favourable variation,” says, “It is good thus to try in our imagination to give any form some advantage. Probably in no single instance shall we know what to do so as to succeed.”—*Origin of Species*, p. 78.

“struggle for existence,” such as would imply, or admit of “survival of the fittest;” there is no evidence of any such “natural selection” as would result, or has ever resulted, in improvement of any species. I have elsewhere* fully demonstrated these positions, and will not longer dwell upon them.

What we want in the nature of proof is this: that we should see an indication of the *possibility* of some change in the physiological relations of the various members of a group or species. We are not so irrational as to demand to witness the whole of the actual process of conversion of one species into another. By the hypothesis this process is so slow, that probably millions of generations† might be required for its completion. But if it be a real process going on at all times, in accordance with the alleged uniformity of nature’s operations, what we should expect to see, and what under the circumstances we should inevitably see at one time or another, would be a more or less marked variation in the fertility *inter se* of the various members of a species. If specific characters were plastic to any extent, we should assuredly, amongst the thousands upon thousands of species with which we are acquainted, now and then catch sight of some slight indication of such plasticity. This, however, is entirely wanting, and with it the *only* evidence which could be conclusive as to organic evolution. To search out and to know the “causes of things” is a necessity of our intellectual nature; but if they are to *satisfy* our unceasing cravings for knowledge these causes must be *efficient*. To those who are content with any formula including the names of things to be explained, it may be deemed satisfactory to say that “Tenterden church steeple is the cause of the Goodwin sands;” but it is certainly a surprising phenomenon to find *philosophers* content to reiterate, ever and again without proof or explanation, that mechanical force is competent to account for the formation of living matter from its inorganic elements; and that all the varied forms of organic life have resulted from the continued operation of the same force.

3. Before accepting with all its consequences the doctrine of man’s lineal descent from an ape, we require further evidence as to the solidarity of his nature, taken as a whole, with that of the brute. Haeckel admits that the acceptance of the general theory of evolution (*Descendenz-Theorie*) does not absolutely necessitate the acceptance of the “particular case” of man’s descent from the ape. The general theory is, according to him, to be considered as fully established, as being a “conquest of science,”—not to be doubted or discussed. Any particular case or illustration of it may be viewed as more or less hypothetical, in accordance with the evidence. The pedigree of man may thus be discussed within certain limits; say as to the special form or type of brute from which he sprung; although in Haeckel’s own

* Winds of Doctrine, chap. iv.

† Darwin, *op. cit.*, p. 124.

mind the demonstration of his descent from the catarrhine ape is as certain as that of any truth in any department of science. On the contrary, as the question stands at present, I would venture to assert that the evidence taken as to man's entire nature is altogether and conclusively in favour of a *distinct* and *special* origin, whatever that origin may be.

I accept without hesitation all that has been, or can be, said as to the morphological relations existing between man and the higher apes. I recognize to the fullest extent the close resemblance between their respective organizations, and that "the structural differences which separate man from the gorilla or the chimpanzee are not greater than those which separate the gorilla from the lower apes."* For on the same high authority we are told that man is "*the only consciously intelligent denizen of this world*," and that in his entire nature there is an "*immeasurable and practically infinite* divergence of the human from the simian stirps"†—a statement of the utmost significance, involving a final and perfect demonstration that as regards man, his whole nature is *not* defined and limited by his structure and organization. For with a certain difference in structure between the lower apes and the gorilla, we find perhaps a corresponding, moderate, but certainly *finite* and easily measurable, difference of *nature* between them; whilst with a *less marked difference* of structure between the gorilla and man, we have a divergence of nature not to be measured, but "*practically infinite*." Can any more complete or cogent demonstration be desired to show that the specific characteristics of man are not to be defined in terms, or by details, of his bodily structure? It is by his moral nature, by his capacity for a religious sentiment, by his power of conceiving abstract ideas of truth, justice, right, and wrong, by the possession of articulate speech, and of a *conscious* reasoning, reflective, and volitional faculty, that it is demonstrated that man is neither of nor from the brute—"that he differs fundamentally from every other creature which presents itself to our senses; that he differs absolutely, and therefore differs in origin also."‡

Morphology has much to say on this subject, wherever it comes into question—much that is highly interesting and instructive—but nothing that is conclusive. Morphology is not the science of humanity, or human nature. Palæontology, as already seen, throws but little light on the subject, on one side or the other. What it does actually reveal, so far as our discoveries go at present, is altogether in support of the view that man's origin was not by slow development from an ape. Quaternary man is an established fact—tertiary man is a problem. But apart from the question of distribution in time, the lesson

* Professor Huxley, quoted by Haeckel (C), p. 37.

† Man's Place in Nature, p. 103.

‡ Lessons from Nature, by Mr. St. George Mivart, p. 190.

taught by the earliest human remains is, that they belonged definitely and certainly to men *such as men are now*, and not to apes, or to "ape-men." The *demonstration*, then, in any proper sense of the word, of man's ape-descent is still to begin. The *doctrine* is an unverified, and not only that but an unsupported hypothesis, and as such can only be regarded as a "figment of the imagination."

Under these circumstances, it might naturally have been supposed that the question about the public teaching of such doctrines was scarcely an urgent one, and that we might well wait for further knowledge. But it is interesting as well as curious to see what very different views can be taken by thoughtful men of even so apparently simple a question as this—Shall we teach what we know, or what we do not know? Haeckel very strongly advocates the public and compulsory teaching of the Evolution-theory in general, and of the ape-descent hypothesis in particular, partly because it is, in his estimation, the highest education which the human mind is capable of receiving; but chiefly because it will free us from all Church-dogmas, superstitions, and religions, which are usually but immoral arrangements, fortunately only short as to duration, the "longest scarcely lasting more than two thousand years, which is almost an imperceptible point of time as compared with the æons of the geological periods."* The reception of this teaching will also open to us the way to a new basis of morals, which, instead of being founded upon "pretended revelations,"† will be derived from a recognition of our true place in nature, and from a contemplation of the habits and manners of the ants and other social and gregarious communities, and a due appreciation of the "sense of duty" (*Pflicht-Gefühl*),‡ which impels them to so admirable a life. He suggests that "the Church-religions should utilize, instead of opposing, this creed. For not to those theologians belongs the future who wage a hopeless warfare against the victorious doctrines of Evolution, but to those who acknowledge, realize, and take possession of it."§

Virchow adopts an opposite view, both for the reasons already quoted and for others. He recognizes that natural science with justice claims to have an influence in the schools, that a knowledge of nature should be admitted in a greater measure into the regular course of teaching. But he considers that to leave it "a question for the educators" to decide whether the theory of evolution shall be at once laid down as the basis of instruction, and the plastidule-soul be assumed as the foundation of all ideas concerning spiritual being;

"whether the teacher is to trace back the origin of the human race to the lowest classes of the organic kingdom, nay, still further, to spontaneous generation; that is, in my opinion, an inversion of the questions at issue.

"If the Evolution-theory is as certain as Dr. Haeckel assumes it to be, then we must demand, then it is a necessary claim, that it should be introduced into

* A, p. 18.

† Ibid., p. 20.

‡ Ibid., p. 81.

§ A, p. 19.

the schools. How could it be conceivable that a doctrine of such moment, which lays hold of every one's mind as a complete revolutionary force, the direct result of which is to form a sort of new religion, should not be imported in its completeness into the scheme of our schools? How would it be possible to keep a dead silence about such a *revelation*? . . . Every schoolmaster who accepted this doctrine would teach it, however unintentionally. How could it be otherwise? He must play the complete hypocrite, he must artificially lay aside his own knowledge for the time, if he would not betray the fact that he acknowledges and firmly holds the Evolution-theory, and that he knows exactly how man comes into being and whence he is derived. . . . I say, therefore, that even if we did not demand the introduction of the Evolution-theory into the plan of the schools, it would come in of itself.”*

But he points out that, being still in want of demonstration, there are certain dangers attendant upon its promulgation, not the least of which is the fact that what is given forth as a theory, “perhaps with a certain degree of modest reserve,” is liable to be carried further by the outer world with ever-increasing confidence; to grow and expand, and return to us in a form which startles and shocks us. Of this danger he gives a striking and interesting illustration from his own experience in reference to his cell-doctrine, which was perverted and distorted by certain writers to such an extent that it was extended to all the phenomena of the visible universe, of which it was supposed the heavenly bodies represented the cells. On the whole he urges the wise advice—wait and investigate.

Professor Huxley, addressing the department of Anthropology at the recent meeting of the British Association, makes some very interesting and suggestive remarks appropriate to this question. Having alluded to various *loci* of disturbance, a very marked instance of which used to exist in the Geological section, and is now to be found chiefly in the Anthropological division of the Biological section, he says:—

“History repeats itself, and precisely the same terrible apprehensions which were expressed by the aborigines of the Geological section, in long far-back time, are at present expressed by those attending our deliberations. The world is coming to an end, the basis of morality is being shaken, and I don't know what is not to happen, if certain conclusions which appear probable are to be verified. . . . Well now, depend upon it, whoever is here thirty years hence will find, exactly as the members of the Geological section have found, on looking back thirty years, that the very paradoxes and conclusions, and other horrible things that are now thought to be going to shake the foundations of the world, will by that time have become parts of every-day knowledge, and will be taught in our schools as accepted truth, and nobody will be one whit the worse. . .

“The region of pure physical science, and the region of those questions which specially interest ordinary humanity, are apart; and the conclusions reached in the one have no direct effect in the other.”

These views are important, as coming from so high an authority; yet, did my almost exhausted space permit, it might be shown that they are not altogether beyond controversy. Time alone can determine the truth or error of the prophecy that these doctrines will in due time be the accepted truths of our schools. I think it just possible, on

* Virchow (B), pp. 15, 16.

the other hand, that long before the end of the time mentioned, the world will have asked so often and so urgently for some confirmation of them, on Professor Huxley's own terms, that is, by "observation and experiment," and have so uniformly failed in obtaining anything more than monotonous reassertion, that the doctrines may have been dismissed to the limbo of other wild guesses at truth.

Whether if taught and accepted, no one will be "one whit the worse," I think, likewise open to doubt. The world was certainly not one whit the *better* for the attempt made towards the close of the last century, in a sister country, to set aside the idea of a Creator, and to enthroned "Reason," in His place; nor do I think the apotheosis of Evolution is likely to lead to much better results. If the *monistic* doctrine be true, then man is no longer a free agent, but an automaton to whom virtue and vice are equally unmeaning and impossible. Whether a widespread or universal acceptance of this position would lead to the refined morality which Professor Haeckel anticipates from it, or whether it would tend to the subversion of all society and to utter chaos, may be left to the common sense of the community to conjecture.

I hold that the world *is* the worse already for the promulgation of these pseudo-scientific doctrines. I do not think that practical and speculative philosophy are ultimately to be kept apart, and I believe that no one would be more honestly astonished and shocked than Professor Huxley himself, could he know how often it has occurred to myself to hear his own doctrine concerning the "Physical Basis of Life" quoted as *the* authority in arguments involving contempt for human life and especially infant life. As Virchow observes, it is not altogether the question what we ourselves mean by our theories, expressed with "modest reserve," as what the rough and trenchant logic of the outer world makes of it. And *this* is what is made of the Evolution doctrine generally: "The dog has just as long a pedigree as we have; he descended from the same original pair of vertebrata; and, tracing these backwards, our common origin was a molecule of protoplasm, which had been formed by mechanical force from carbon, hydrogen, oxygen, and nitrogen. What essential difference then is there between man and the dog, and why should we hesitate to do to the one, what we do daily to the other?" *

The general question of organic ontology has reached a very unsatisfactory stage, but one in which probably it cannot long remain. The doctrine of "advanced" evolution, as applied to the origin of life and the development of organic forms, has been again and again shown to be beset on all sides not only with improbabilities but with absolute physical impossibilities, to be supported by no direct evidence, and to be opposed by the results of all "experiment and observation." Yet undismayed by this, its upholders ever and again return to their formulas, which are full of sound and promise, but end

* Not an imaginary address.

in emptiness and disappointment. "*Credo quia impossibile*" would appear to be inscribed on their shield. They offer no argument, nor any reason why we should be called upon to believe in a principle whose only merit seems to be that it is not susceptible of demonstration; yet they look down with a kind of lofty and impatient compassion upon all who think differently from themselves. But contemptible as is nowadays the belief in anything but Evolution, I think I would rather be distinguished by that ignorance which is in accordance with all the observed facts and phenomena of nature, than by that enlightenment whose high-sounding motto is *Impavidi progrediamur*,* which believes in nothing but the unproven, and has little else to recommend it beyond impossible paradox and noisy pyrotechny.

CHARLES ELAM.

* The motto affixed to Haeckel's "Reply."

